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Impacts of Economic and Socioeconomic Changes on Potato Use

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Abstract: Total per capita consumption of potatoes remained constant between 1970 and 1985. However, consumption of fresh potatoes declined 20 percent, while consumption of processed potato products increased 20 percent. Decreased fresh consumption is attributed mainly to increased consumer income, growth of away-from-home food consumption, and a larger proportion of women in the labor force. Interestingly, these are also the factors which boosted demand for processed potatoes. As usage of processed potatoes grew, production shifted from Northeastern States, which produce predominately fresh-market potatoes, to Pacific Northwestern States, which produce predominately processing potatoes. Many Northeastern States are shifting acreage out of round white potatoes and into russet potatoes. This trend, as well as other economic and socioeconomic factors, could impact regional shifts in production and total potato consumption.

Key Words: Consumption, production, prices, demand, fresh potatoes, processed potatoes, market share.

Rapid change is occurring throughout the U.S. potato industry. Production of potatoes is shifting away from Northeastern States and toward the Pacific Northwestern States of Idaho, Oregon and Washington. Consumption is shifting away from fresh potatoes and toward processed potato products. Coupled with these changes are widespread economic and socioeconomic changes in the U.S. economy. Increases in per capita income, away-from-home food consumption, labor force participation rates for women, and other factors are influencing the consumer preference function in favor of foods with more built-in maid services. As these changes evolve, considerable uncertainty is created as to the outlook for potato production and consumption. The interaction of economic and socioeconomic factors could lead to increased potato consumption, decreased consumption, or stable consumption with tradeoffs between fresh potatoes and processed potato products. Likewise total potato production could increase, decrease or remain stable. Hence, this paper examines the relationship among

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the aforementioned changes and discusses the implications for future potato use and regional potato production.

Although rapid change characterizes the U.S. potato industry for the past four decades, this paper focuses on the 1970 to present period. This period is especially relevant because it encompasses several measures that have been implemented to reverse declining consumption of fresh potatoes: (a) improved nutritional information about potatoes; (b) new and improved marketing strategies; and (c) a self-imposed tax on all potato producers for advertising and promoting potatoes. To evaluate the impacts of these direct measures together with those of other economic and socioeconomic factors, a simultaneous econometric model with thirteen (13) equations is employed (see Appendix A). As specified, the model consists of retail demand equations for fresh potatoes, chips, dehydrated and frozen potatoes; retail price equations for the aforementioned products (all price equations are expressed in 1967 dollars); wholesale price equations for the three processed potato products; and finally, a farm production and farm price equation. The complete model and estimated results are shown in Appendix A.

Consumption and Production Trends

Since 1970, total consumption of potatoes has remained relatively constant at 121.9 pounds per capita (5). Dramatic changes, however, have occurred in the composition of potato consumption. Fresh potato consumption declined during this period from 61.4 pounds per capita to 49.3 pounds, a decline of 19.7 percent. By comparison, consumption of all processed potato products (chips, frozen, dehydrated and canned) increased from 60.4 pounds to 72.4

consumption increases were realized for frozen potato products, rising from 28.9 pounds (1970-71) to 42 pounds (1984-85) per capita. This represents an increase of 45.1 percent. Chip consumption rose a moderate 5.2 percent while dehydrated and canned consumption fell 15.2 and 4.8 percent respectively.

Production of raw potatoes increased during the aforementioned period from an average of 322.6 mil cwts to 384.8 mil cwts, an increase of 19.2 percent. However, the Pacific Northwestern States of Idaho, Oregon and Washington gained market shares amounting to 9 percentage points while the Northeastern States[1] lost market shares totaling 9 percentage points. Although relative market shares have changed, together the two regions continue to produce 58 percent of total U.S. production.

Potato Use only Marginally Impacted by Own Prices

A finding common to all but one of the estimated demand equations is that own prices have an insignificant impact on potato consumption. That is, a proportionate change in prices for all forms of potatoes would lead to little change in total consumption. The one exception is dehydrated potatoes, in which a 10 percent increase in price causes a 2.2 percent decline in quantity demanded. Additionally, dehydrated potato products are shown to be a strong substitute for fresh potatoes. A 10 percent increase in the price of fresh potatoes leads to a 5.8 percent increase in consumption of dehydrated products. By contrast, changes in fresh potato prices have essentially no impact on

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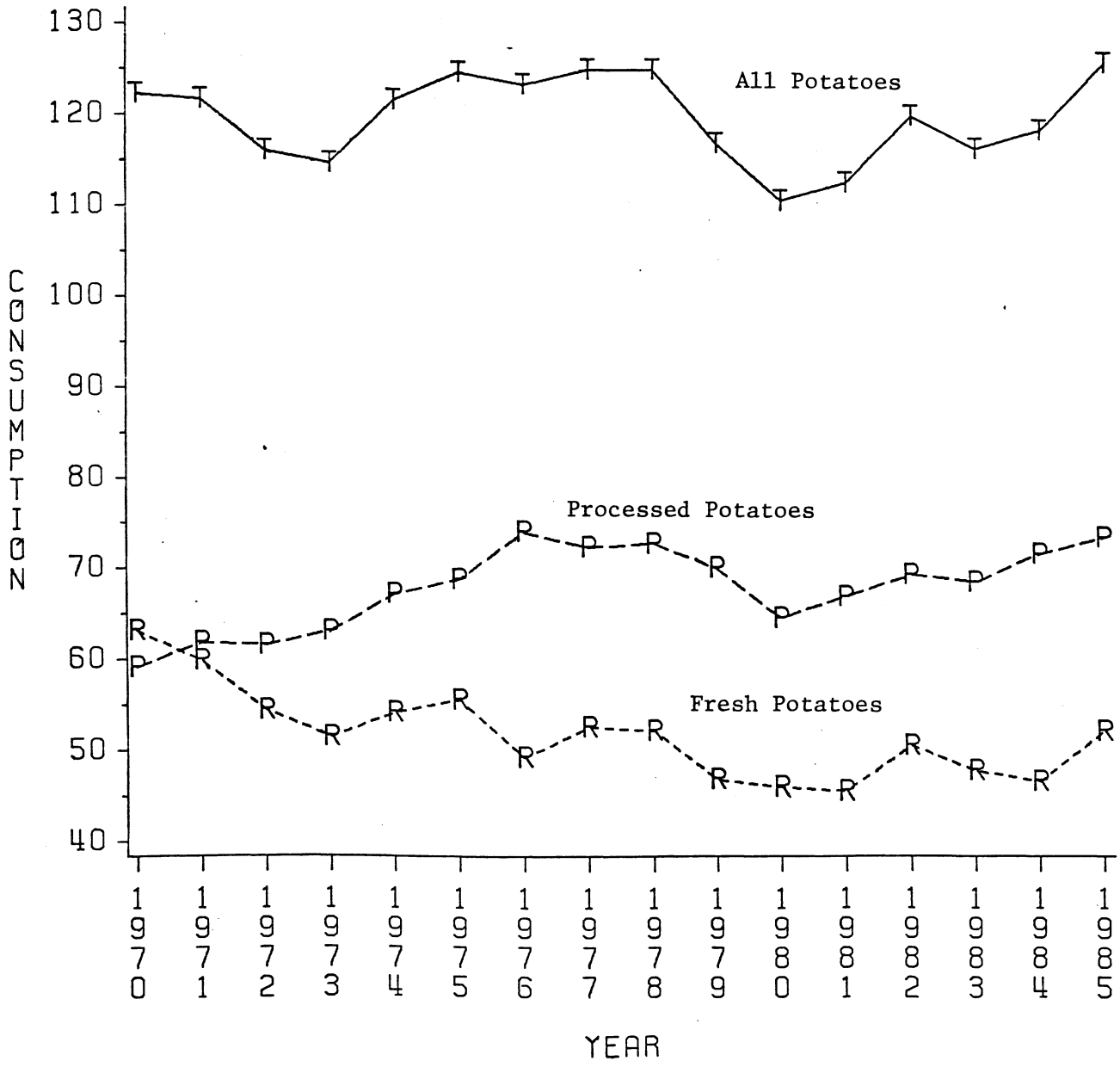
[1]Northeastern States are defined as Connecticut, Maine, Massachusetts, New Hampshire, New York, Pennsylvania, Rhode Island and Vermont.

Figure 1. PER CAPITA CONSUMPTION OF POTATOES



demand for chips and frozen potatoes. These findings suggest that potatoes are too small a part of the consumer food budget to have been impacted by the range of price changes during the 1970-85 period. Additionally, since increases in fresh potato prices lead to increased consumption of dehydrated potatoes only, this suggests that other forms of potatoes are perceived by consumers to be poor substitutes for fresh potatoes.

While changes in fresh potato prices influenced dehydrated demand only, estimated results do show increases in fresh potato consumption resulting from changes in frozen potato prices. A 10 percent increase in the price of frozen potatoes generates a 2.5 percent increase in fresh demand. This finding suggests that changes in frozen potato prices were significant enough to cause some consumers to switch from frozen to fresh potatoes. This substitutability occurred even though the estimated results show that frozen potato demand is determined largely by nonprice factors. These factors include income, advertising, fast-food consumption, and women working away from home.

Rising Income Hits Fresh Consumption

Rising consumer income during the 1970-85 period led to drastic declines in fresh potato consumption. The estimated results show a 4.2 percent decline in consumption of fresh potatoes for each 10 percent increase in per capita income. By comparison, consumption of frozen potatoes increased 8.1 percent for each 10 percent increase in per capital income; consumption of chips and dehydrated potatoes was unaffected by income changes. These findings suggest that consumers switch from fresh potatoes to frozen potatoes as their income increases. The unresponsiveness of chips and dehydrated potato consumption to

income changes suggests that these products are consumed in fairly constant proportion by all income groups.

While the income elasticity response seems quite large for frozen potatoes, it should be emphasized that real per capita income (1967 dollars) increased only 20 percent between 1970 and 1985. Frozen potato consumption, however, increased 53 percent, rising from 27.7 pounds to 42.4 pounds. Hence, the elasticity estimate suggests that 16 percent of this change in consumption is due to income growth.

Advertising Boosts Potato Consumption

Revenues collected form a 1972 self-imposed tax on potato producers are allocated partly for advertising (generic) fresh potatoes and some processed potato products. Additionally, most processed potato products are also advertised (brand) by their manufactures. And recently, frozen potatoes have received additional advertising and promotion funds through the Targeted Export Assistance (TEA) program. These TEA funds are used exclusively to promote frozen potatoes in the Pacific Rim countries of Hong Kong, Indonesia, Japan, Malaysia, Singapore and Taiwan. The effectiveness of these expenditures are evaluated below.

Generic advertising has a positive impact on fresh potato demand. However, generic advertising expenditures are more effective in stimulating increased demand for frozen and dehydrated potatoes than for fresh potatoes. A 10 percent increase in generic advertising expenditures lead to a .9 and .6 percent increase in consumption of dehydrated and frozen potatoes respectively. By comparison, consumption of fresh potatoes increases by .06 percent for each 10 percent increase in generic advertising expenditures. These elasticity

differentials could be influenced by the fact that generic advertising for processed products is coupled with "brand" advertising, while fresh potatoes receive no "brand" advertising. Indeed "brand" advertising expenditures for a given year typically exceed "generic" expenditures by a factor of at least 14.

Although potato chips have not received any generic advertising expenditures, the estimated results show that "brand" advertising expenditures have a positive influence on chips consumption. Recognizing the lag effect of advertising expenditures, the results show that a 10 percent increase in both current and lagged (one year) advertising leads to an increase in chips demand of .28 and .26 percent respectively. More specifically, a $5 million increase in chips advertising from the approximately $50 million in 1985, would lead to less than a one-tenth pound increase in chips consumption.

Brand advertising expenditures also boost demand for frozen and dehydrated potatoes. A 10 percent increase in current and lagged (one year) advertising expenditures for frozen potatoes leads respectively to a .3 and .2 percent increase in demand. An even larger effect is realized for dehydrated potatoes, with current and lagged demand increasing .4 and .3 percent respectively for each 10 percent increase in brand advertising. These elasticity differentials could reflect the fact that a larger share of frozen potatoes, than dehydrated potatoes, are marketed through institutional establishments where advertising is less effective. Even so, frozen potatoes are likely to show more growth than dehydrated potatoes because, unlike dehydrated potatoes, all the included economic and socioeconomic factors have a positive influence on frozen demand.

Although the estimated results for this study do not reflect expenditures of the recently initiated TEA program, some preliminary results have been reported by the National Potato Board(3). In general, the $2 million promotion

expenditures for 1986 in five (Indonesia only recently added) Pacific Rim Countries served to increase frozen potato sales in all countries. Total sales of U.S. frozen fries in these countries in 1986 amounted to 72,481 metric tons, representing an increase of more than 28 percent from the 1985 total of 56,350 metric tons. These totals represent percentage increases which range from 10 percent for Malaysia to 624 percent for Taiwan. This growth of frozen potato sales was accomplished with expenditures of $2 million. The Potato Board is projecting even more growth for 1987, particularly since additional revenues ($2.4 million) have been allocated for promoting potatoes in the six Pacific Rim countries.

Fast-food Consumption Boosts Frozen Potato Sales

Estimated results for this study show a 2.2 percent increase in frozen potato consumption for each 10 percent increase in fast-food sales. Using the 1985 frozen potato consumption rate of 42.4 pounds, this elasticity suggests that a 10 percent increase in fast-food sales would lead to an increase of nearly one pound in per capita consumption of frozen potatoes. Of course, fast-food sales remained fairly constant between 1984 and 1985.

While fast-food sales serve to increase frozen potato sales, the results show clearly that all away-from-home food consumption has a negative influence on consumption of fresh potatoes. Indeed, a 10 percent increase in away-from-home food consumption leads to a 4.3 percent decline in fresh consumption. This estimate suggests that fresh potatoes, unlike frozen potatoes, are more of a retail than an institutional food item. Of course, the current trend toward baked potatoes at fast-food establishments could influence the marketing pattern for fresh potatoes(4). The 1970-85 study period of this study is

probably insufficient to capture the full impact of the 1982 introduction of baked potatoes at fast-food establishments. Though it should be emphasized that baked potatoes are targeted to adult women who have not been major consumers of fast-foods.

Working Homemaker Hits Fresh Consumption

The percentage of women in the labor force increased from 36 percent in 1970 to 43 percent in 1985. This trend served to depress demand for fresh potatoes. The estimated results show that each 10 percent increase of women in the labor force leads to a 1.6 percent decline in fresh consumption. A similar trend is observed for dehydrated potatoes, with per capita consumption declining 4.9 percent for each 10 percent increase of working women. These elasticities suggest that fresh and dehydrated potatoes do not benefit from the convenience demand that is thought to be reflected in increased participation of women in the labor force.

Per capita consumption of frozen potatoes is boosted by increased labor force participation of women. Frozen potato consumption is increased 3.4 percent for each 10 percent increase of working women. And while the labor force participation rate of women is a socioeconomic factor which is believed to measure demand for convenience, differentials in demands for frozen and dehydrated potatoes should be noted. That is, even though dehydrated potatoes have convenience characteristics, per capita consumption of these products has not shown a positive response.

Farm, Wholesale and Retail Price Relationships

The estimated results show a weak relationship between the farm price of potatoes and the wholesale price for the various processed potato products. Indeed, the wholesale price of chips was not strongly influenced by either the current or lagged farm price. Wholesale price changes in frozen potatoes were closely linked to lagged farm price, whereas wholesale price changes for dehydrated potatoes were more closely linked to current farm price. The results also reveal that a $1 change in farm price results in less than a $1 change in wholesale frozen potato prices, but a $1.77 change in wholesale dehydrated potato prices.

Retail and wholesale prices for chips, frozen potatoes and dehydrated potatoes are closely linked. Approximately one-half of a price change in the wholesale price of chips and dehydrated potatoes are passed through immediately at the retail level. By contrast, six-tenths of a wholesale price increase for frozen potatoes is reflected immediately at the retail level. The results also show that the spread between wholesale and retail prices for chips and dehydrated potatoes widen during the 1970-85 period.

Frozen Potato Consumption Favors Western States

Western states have a comparative advantage in producing russet potatoes that are preferred for frozen potatoes. This is especially true for the Pacific Northwestern States of Idaho, Oregon and Washington which have soil, climate and irrigation systems that are ideal for producing russet-type potatoes. However, as russet potatoes have become competitive in the fresh market and often command price premiums, many Non-Western States have begun to increase their production of russets. For example, Maine's production now consists of at least 25 percent russets. This increased production of russets

in Non-Western States is not expected to impact the Pacific Northwestern State's share of the frozen and dehydrated potato market. However, because of the high transportation cost for fresh potatoes, Non-Western States are expected to increase their competitiveness in supplying "bakers" and fresh potatoes.

Changes in market grades and sizes can also have an impact on the relative competitiveness of producers. Recent evidence suggests that Canada is gaining fresh market share in Northeastern cities because of improved grades and sizes(1). As Northeastern States realign their production to supply more russet potatoes, their competitiveness with Canada and Western States is likely to be enhanced. Moreover, with current consumption data pointing to increased demand for fresh potatoes, regional production patterns could favor Northeastern States.

Potato Production and Farm Price

Annual potato production is determined primarily by the previous year's price, alternative cropping opportunities, and the previous year's production. The empirical results show that a 10 percent increase in the farm price of potatoes will cause a 3 percent increase in production in the subsequent year. Moreover, potato production is shown to be reasonably constant from year to year, with only 36 percent of the adjustment toward long-run equilibrium occurring during the first year. This adjustment process suggests that many potato producers have either high fixed cost investments in potato production or limited alternative cropping opportunities. Indeed, the one crop (sugar beets) which is an alternative commodity for many potato producers, causes only a 1.2 percent decrease in potato production for each 10 percent increase in the

price of sugar beets. Potato production is not significantly influenced by production risk, as measured by the coefficient of variation of monthly prices.

Changes in farm-level potato prices were expected to be explained by current period production and a one-year lag of production. As estimated, these factors explain only 22 percent of the total variation in potato prices, with current production having a statistically insignificant influence. Lagged potato production generates a price flexibility coefficient of -1.7, suggesting a 1.7 percent price response for each 1 percent quantity change. Since a product with an inelastic demand is expected to have a price flexibility coefficient greater than one in absolute value, it may be observed that this estimate is consistent with demand theory. The inability of production changes to explain a larger proportion of farm price variations may be due to an inadequate reflection of preseason contracts in farm gate prices.

Summary and Conclusion

The results of this study show that changing economic and socioeconomic factors are having a significant and positive influence on demand growth for frozen potatoes. This positive influence is especially strong for rising per capita income, increased labor force participation of women, and growing consumption of fast foods. By contrast, these factors have either a negative or neutral influence on consumption of chips, dehydrated and fresh potatoes. However, both chips and dehydrated potatoes are positively influenced by brand advertising. Generic advertising is also shown to have a positive influence on consumption of dehydrated, fresh and frozen potatoes. Moreover, TEA promotion expenditures, according to the National Potato Board, are generating tremendous demand growth for frozen potatoes in Pacific Rim countries. The confluence of

these factors suggests that future growth in demand for frozen potatoes is likely to outpace that for chips, dehydrated and fresh potatoes.

As the demand for russet potatoes for frozen processing expands, Northeastern States could face less fresh market competition from Western States. Potato production or regional shares could also be influenced by increased production of russets in Non-Western States, increased sales of "bakers" at fast-food establishments, and expanding fresh potato sales through salad bars at fast-food establishments. While all of the trends were too recent to quantify and measure in this study, their potential for stabilizing and/or reversing declining production for Northeastern States is recognized by most potato marketing specialists. This stabilizing influence results from the transportation economies Northeastern States realize in supplying fresh potatoes to large population centers.

This study clearly recognizes that much of the growth in total potato consumption during the past two decades has come from the tremendous consumption of potato products at fast food establishments. Unprecedented growth of the fast-food industry during the 1970's led to rapid demand growth for frozen french fries. Demand growth for frozen french fries at fast food establishments has diminished during the 1980's, but frozen potatoes still show more growth than fresh potatoes or any other processed form. Since the results of this study suggest that prices are not a major determinant of demand, it is likely that frozen potatoes will provide future growth for the potato industry because of the positive influence emanating from various economic and socioeconomic factors.

APPENDIX A

Table C: Estimated Model of the U.S. Potato Industry

Empirical Results

(1) QRP = -1711.76 + 22.01 FPFL - 24.78 PSL + .879 TR - .069 RSL + .648 QRPL
(-2.25)** (6.75)* (-6.37)* (2.32)** (-.53) (5.56)*

(2) UZF = 52.389 + .826 RPF + .576 RPR + .351 RPT - .0003 TF - .0069 IN -
(51.8)* (1.79) (3.73)* (.904) (-7.61)* (-6.35)*

57.02 WN
(-7.81)*

(3) UZC = 16.85 + .006 RPC - .293 RPR - .000008 IN + .20805 UN + .0495 AC +
(78.9)* (.75) (-7.09)* (-.016) (4.11)* (1.67)

.054 ACL
(2.68)**

(4) UZR = 38.18 - .09 RPF + .448 WPR + 2.32 RPT + 24.97 FF + .009 IN +
(53.46)* (-.307)* (1.68) (6.78)* (7.98)* (9.01)*

32.56 WN + .45 AR + .42 ARL
(8.39)* (4.1)* (5.2)*

(5) UZD = 13.86 - .045 RPD + 1.00 RPF + 1.33 RPT - .00002 IN - 16.87 WN +
(32.65)* (-2.22)** (6.9)* (8.5)* (-.035) (-3.1)*

.283 AD + .204 ADL
(2.3)** (1.78)

(6) RPF = 4.56 + .312 FPF + 1.24 FPFL + .125 MK
(7.31)* (1.9) (8.2)* (.71)

(7) RPC = 86.53 + .506 WPC - 2.65 MK + .45 TR
(95.8)* (23.0)* (-6.04)* (6.51)*

(8) RPR = 22.93 + .61 WPR - .013 TR + .747 FR - .10 MK
(43.9)* (2.11)** (-.40) (.26) (-.55)

(9) RPD = 70.59 + .49 WPD − .16 MK + .09 TR
(130.1)* (11.1)* (−.51) (2.16)**

(10) WPC = 54.5 + 1.87 FPF + .81 FPFL − 2.44 MK
(9.7)* (1.36) (.55) (−1.45)

(11) WPR = 11.25 + .26 FPF + .79 FPFL − .31 MK
(11.4)* (.95) (3.08)* (−1.26)

(12) WPD = 24.18 + 1.77 FPF + 1.14 FPFL − 6.15 MK
(5.85)* (2.71)** (1.15) (4.62)*

(13) FPF = 6.99 − .0089 QRP − .023 QRPL
(2.97)** (−.68) (−2.06)**

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t-ratios in parentheses; all t-tests are one-tailed
* significant at .01 level
** significant at .05 level

Endogenous or Estimated Variables

QRP - Total potato production expressed in pounds per capita.

UZF - Utilization of potatoes for fresh consumption in pounds per capita.

UZC - Utilization of potatoes for chips in pounds per capita.

UZR - Utilization of potatoes for frozen potatoes in pounds per capita.

UZD - Utilization of potatoes for dehydrated potatoes in pounds per capita.

RPF - Retail price of fresh potatoes in real dollars (1967) per hundred weight.

RPC - Retail price of chips in real dollars (1967) per hundred weight.

RPR - Retail price of frozen potatoes in real dollars (1967) per hundred weight.

RPD - Retail price of dehydrated potatoes in real dollars (1967) per hundred weight.

WPC - Wholesale price of chips in real dollars (1967) per hundred weight.

WPR - Wholesale price of frozen potatoes in real dollars (1967) per hundred weight.

WPD - Wholesale price of dehydrated potatoes in real dollars (1967) per hundred weight.

FPF - Farm price of potatoes in real dollars 91967) per hundred weight.

RPT - Generic advertising expenditures expressed in 1967 dollars.

Exogenous or Explanatory Variables

IN - Disposable personal income in real dollars (1967) per capita.

FF - Fast-food expenditures as a percentage of total away-from-home food expenditures.

TF - Total away-from-home food expenditures expressed in 1967 dollars.

WN - Women in the labor force expressed as the percent of women to total labor force.

UN - Unemployment rate expressed on an annual basis.

AC - Total brand advertizing expenditures for potato chips expressed in 1967 dollars.

AD - Total brand advertising expenditures for dehydrated potatoes expressed in 1967 dollars.

AR - Total brand advertising expenditures for frozen potatoes expressed in 1967 dollars.

MK - An index of food marketing costs for all fruits and vegetables. This variable is intended to serve as a proxy for the non-reported marketing index for potatoes.

TR - A trend variable representing the 1970-85 period. This variable serves as a measure of technological change in the production equation (QRP) and as a proxy for the changing spread between retail and wholesale prices in equations 7 through 9, Table C.

FR - This variable represents the share of all frozen potatoes marketed through retail establishments. As FR increases, the retail price of frozen potatoes is hypothesized to increase.

QRPL - A one year lag of QRP.

FPFL - A one year lag of FPF.

ACL - A one year lag of AC.

ARL - A one year lag of AR.

ADL - A one year lag of AD.

RSL - Risk associated with potato production. This variable is expressed as the coefficient of variation of monthly potato prices at the farm level.

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